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BROOKLYN BOTANIC GARDEN

LEAFLETS

SERIES XIX

BROOKLYN, N. Y., APRIL 1, 1931

No. 1

HOUSE PLANTS*

It is well to recognize that many difficulties have to be faced before plants can be grown successfully in an ordinary dwelling house, but, by giving careful attention to cultural details these can often be overcome. The hot, dry atmosphere, the fumes of illuminating gas, insufficient light, and great variation in day and night temperature, all tend to make their cultivation a difficult operation. However, in spite of these drawbacks, it is possible to grow a fairly large variety of plants in an ordinary house, and one need not be limited to the ubiquitous India rubber plant. It is among the so-called "foliage" plants that the greatest number of suitable subjects for the purpose under consideration are to be found. The Boston ferns, dracaena, pandanus, aspidistra, and sansevieria are well adapted to withstand adverse conditions. In selecting flowering plants, those should be chosen, as far as possible, which make a large part of their growth out-of-doors. Among this class of plants are the forcing bulbs, such as hyacinths, tulips, crocus, and the well-known azaleas. Primroses and cyclamens will also last a fairly long time in good condition.

The best aspect for the majority of plants is in a window facing south or southwest, as there are comparatively few plants that will grow satisfactorily without abundance of light. If a well-lighted position is not available, one's choice is almost entirely restricted to foliage plants. A bay window on the sunny side of a house will provide almost ideal conditions for a considerable number of plants, and a delightful effect may be obtained by growing them either in pots or in boxes constructed to fit the window.

Temperature is an important factor in the successful cultivation of plants, and violent fluctuations should be avoided as far as possible. If, as often happens, warmth-loving plants are grown in a room which is unheated at night, they should be protected in some way during severe weather. This may be done by removing

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them to a heated room or away from the windows. If this is impossible, they can be protected by covering them at night with paper or other non-conducting material. It is a fact that the overheated, arid air of the average apartments is perhaps the most potent of the contributory factors causing the early demise of the plants grown in them. The temperature, in winter, should not be allowed to exceed 70° and if the air can be humidified it will benefit the plants. Bound up with the question of temperature is that of ventilation. Plants object to impure air as much, or more, than human beings; therefore, the room in which they are grown should be ventilated whenever possible, taking care, however, that cold drafts do not blow directly on the plants.

One is frequently asked, "How often must I water my plants?" To this one is compelled to reply, "As often as they need it." There can be no fixed rule as to the quantity and frequency of the application of water to plants; so much depends upon the humidity of the room in which the plants are growing, the nature of the plant, and the capacity of its roots to absorb water. Whenever watering is done it should be done thoroughly so that the earth is wet all through. No further watering is needed until the earth shows signs of drying out, when another application should be given. Thorough watering is most important, otherwise the earth on the surface of the pot may have the appearance of being moist, while an inch or so below the surface it may be dust dry, greatly to the detriment of the plant.

Those living in a city have difficulty in obtaining a supply of suitable soil for potting purposes, and the best plan in such cases is to obtain from a florist soil ready mixed. The best kind of soil for the majority of house plants is that formed of loam cut from the surface of a meadow, pasture, or lawn. This should be mixed with stable manure in the proportion of three parts soil to one part of manure, piled in a heap, and left for a year or so in order that the grass roots and manure may decay. Using this as a base, by the addition of leaf mold, peat, or sand, for such plants as need it, we have a soil that makes a suitable potting medium for almost any class of plants.

No definite rule can be laid down as to when plants should be repotted. If they are making vigorous root growth this may be done at almost any time; but, as a general rule, repotting is best done in early spring, just before the plants begin their new growth. Repotting into a larger pot should be done only when the pot is crowded with roots, otherwise harm rather than good will result; indeed, much of the unhealthiness in house plants can be traced directly to attempting to grow them in too large a pot. It sometimes happens that repotting is necessary because there are too *few* roots in the pot rather than too many. This occurs when, through over-

watering, the earth becomes sour, and, as a consequence, the roots are unable to maintain themselves in a healthy condition. Plants in this condition should have the soil gently washed from the roots previous to repotting them in fresh, sweet soil. Use pots large enough to contain the roots without crowding them. The new pots should be washed clean and allowed to dry before using. Proper drainage is very important in order that superfluous water may be readily carried off, and this is best obtained by placing a layer of broken pieces of pots or coarse ashes over the bottom of the pot. When repotting into a larger pot, the plant should be turned out of the old pot, placed in position and earth filled in around it, tamping the earth down with a piece of lath or something similar, in order that it may come uniformly in firm contact with the roots. Care must be taken not to pot the plant too deeply: the old ball of earth should be covered with about one-fourth inch of soil.

Owing to the lack of facilities for syringing, plants in dwelling houses rapidly become coated with a layer of dust, and this must be removed if they are to be kept in good health. Those plants having large, leathery leaves are best dealt with by washing, using a soft sponge and tepid, soapy water. This process is too tedious an operation in the case of ferns and plants having small leaves, which should be washed by spraying them with water. Advantage should be taken of warm gentle rains by placing the plants out-of-doors, as they are greatly benefited by this.

The insects most likely to infest house plants are aphids, mealy-bug, scale, and red spider. Aphids can easily be exterminated by spraying, or by dipping them in a nicotine solution; or an insecticide can be made by dissolving ordinary soap in water at the rate of one pound of soap to eight gallons of water. Scale and mealy-bug are more difficult to dispose of. The surest way is to wash them off with a sponge and soapy water; if this is impracticable, kerosene emulsion or one of the proprietary insecticides, used as a spray or dip, will, if persevered in, ultimately dispose of them. Red spider flourishes in a warm, dry atmosphere such as is usually found in living rooms, and if it once obtains a footing it is extremely difficult to control. Washing, as in the case of mealy-bug, is the best remedy; failing this, the under sides of the leaves should be sprayed with water with sufficient force to dislodge the insects.

All house plants are benefited by being placed out-of-doors during the warm summer months. This is especially true of azaleas, which should be placed in a partially shaded position outside as soon as danger of frost is over. All pot plants when grown out-of-doors should have their pots plunged to the rim in earth or ashes, as this helps to prevent the soil from drying out too rapidly, and also effects a saving of labor so far as watering is concerned.

Following is a list of plants that, given reasonable care, will thrive under house conditions:

FOLIAGE PLANTS

<i>Scientific names</i>	<i>Common names</i>	<i>Remarks</i>
<i>Aglaonema marantifolium</i>	Chinese or Japanese Evergreen	May be grown in either water or soil
<i>Araucaria excelsa</i>	Norfolk-island-pine	
<i>Asparagus plumosus</i>	Fern Asparagus	
<i>Aspidistra lurida</i>	Common Aspidistra	
<i>Begonia rex</i>	Rex Begonia	
Cacti in variety		
<i>Cocos weddelliana</i>	Weddell Palm	All palms delight in a well drained rich soil and abundant moisture
<i>Cordyline (Dracaena) indivisa</i>	Blue Dracaena	
<i>Cyperus alternifolius</i>	Umbrella-sedge	Pot should be kept partially submerged in water
<i>Dracaena godseffiana</i>	Gold-dust Dracaena	
<i>Ficus elastica</i>	India Rubber tree	
<i>Ficus pumila</i>	Climbing Fig	Trailer
<i>Hedera helix</i>	English Ivy	Trailer—good for growing in shade. Needs cool temperature
<i>Howea (Kentia) belmoreana</i>	Belmore Palm	
<i>Howea (Kentia) forsteriana</i>	Forster Palm	
<i>Nephrolepis exaltata bostoniensis</i> and many varieties	Boston Ferns	
<i>Pandanus utilis</i>	Common Screw pine	
<i>Sansevieria Laurentii</i>	Snakeplant or Bowstring Hemp	
<i>Saxifraga sarmentosa</i>	Strawberry Saxifrage	Trailer
Succulents in variety		
<i>Tradescantia</i> (several species)	Wandering-jew	Trailer

FLOWERING PLANTS

<i>Azalea indica</i>	Indica Azalea	Likes peaty soil
<i>Begonia argenteo-guttata</i>		Begonias grow best in a compost containing a good proportion of leaf mold
<i>Begonia semperflorens</i>	Perpetual Begonia	
<i>Begonia Thurstoni</i>	Thurston Begonia	
<i>Camellia japonica</i>	Common Camellia	Likes peaty soil
<i>Cyclamen</i>		
<i>Epiphyllum (Phyllocactus)</i> vars.		
<i>Impatiens sultani</i>	Sultan Snapweed	
<i>Pelargonium domesticum</i>	Lady Washington Geranium	
<i>Pelargonium zonale</i>	Horseshoe Geranium	
<i>Primula sinensis</i>	Chinese Primrose	
<i>Zantedeschia (Richardia) aethiopica</i>	Common Calla	Needs rich soil and abundance of water
<i>Zygocactus (Epiphyllum) truncatus</i>	Christmas Cactus	Use rather poor soil
Bulbs in great variety		

Except where otherwise specified, loam, with a small proportion of decayed manure, should be used as potting soil.

The nomenclature followed above is that of "Standardized Plant Names" published by the American Joint Committee on Horticultural nomenclature (1923).

MONTAGUE FREE.

LEAFLETS

IMPORTANT WOODY PLANTS

—TREES, SHRUBS AND WOODY CLIMBERS—
OF GREATER NEW YORK

In order that natural history may be given a larger emphasis in biology instruction in New York City Junior and Senior high schools, the Board of Examiners have recently instituted a field test for candidates for the Junior and Senior High School Biology licenses and for the High School license of First Assistant from which Chairmen are selected. In preparation for these field tests, a special committee on requirements has planned the preparation of lists of common plants and animals occurring here in New York City which teachers might be expected to know. Several of these lists have been prepared and the Board of Examiners has authorized the statement that candidates will not be expected to identify anything not included on these lists.

At the request of the committee on requirements, the list of woody plants has been prepared by Dr. Arthur Harmount Graves, Curator of Public Instruction, Brooklyn Botanic Garden, and the list of herbs by Dr. Henry K. Svenson, Associate Curator of Plants, Brooklyn Botanic Garden. This LEAFLET presents the list of woody plants: the list of herbs will appear in a later issue.*

In the official statement defining the scope of the subject matter for the examination in biology, the phrase "common plants and animals" is used. The list given below includes a few species which are not "common," but they may all be found without difficulty and are considered important as types. The Board of Examiners has authorized the statement that, so far as *woody plants* are concerned, candidates will not be expected to be acquainted with any species not included in this list, but that for the determination of what species are to be considered common, candidates must use their own judgment.

The localities in Greater New York where the species may be found are placed after the common name of each plant. (The Pali-

*Lists of birds and reptiles also included in this ruling have been issued by the New York Association of Biology Teachers.

sades of New Jersey have been included in the New York area). Abbreviations for the localities are as follows:

B. Ter.—Bay Terrace, Staten Island.
B.B.G.—Brooklyn Botanic Garden.
C. Pk.—Central Park, Manhattan.
For. Pk.—Forest Park, Queens.
Inw.—Inwood Park, Manhattan.
Kis. Pk.—Kissena Park, Queens.
L. I.—Long Island.
N.Y.B.G.—New York Botanical Garden, Bronx.
Pal.—Palisades of the Hudson, New Jersey.
Pel. Pk.—Pelham Bay Park, Bronx.
Pros. Pk.—Prospect Park, Brooklyn.
S. I.—Staten Island.
V. C. Pk.—Van Cortlandt Park, Bronx.

Typography and symbols. Species in black type are either native or naturalized. North American species found here only in cultivation, i. e. native in other parts of North America, are in *italics*. Foreign species common in cultivation are in LARGE AND SMALL CAPITALS.

* indicates shrubs.

** indicates woody climbers.

All others are trees.

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1. GINGKO BILOBA L. GINGKO. Commonly cultivated.
 2. TAXUS CUSPIDATA Sieb. & Zucc. JAPANESE YEW. Commonly cultivated.
 3. **Pinus Strobus** L. **Northern White Pine.** B. B. G., N. Y. B. G., Pal., Pel. Pk., V. C. Pk.
 4. PINUS EXCELSA Wall. HIMALAYAN PINE. B. B. G., N. Y. B. G., Pros. Pk.
 5. PINUS NIGRA Arnold. AUSTRIAN PINE. Commonly cultivated.
 6. PINUS SYLVESTRIS L. SCOTCH PINE. Commonly cultivated.
 7. **Pinus rigida** Mill. **Pitch Pine.** Common on Long Island.
 8. LARIX DECIDUA MILL. EUROPEAN LARCH. Commonly cultivated.
 9. PICEA ABIES Karst. NORWAY SPRUCE. B. B. G., N. Y. B. G., Pal.
 10. *Picea pungens* Engelm. Blue Spruce. N. Y. B. G. and commonly cult.
 11. ABIES NORDMANNIANA Spach. NORDMANN FIR. B. B. G., N. Y. B. G., Pros. Pk. Commonly cultivated.
 12. **Tsuga canadensis** (L.) Carr. **Eastern Hemlock.** Inw., N. Y. B. B., Pal., Pros. Park.
 13. CHAMAECYPARIS PISIFERA Sieb. & Zucc. SAWARA CYPRESS. N. Y. B. G., Pros. Pk.

14. *Thuja occidentalis* L. **Northern White Cedar; Arborvitae.** B. B. G., N. Y. B. G.
15. *Juniperus virginiana* L. **Eastern Red Cedar.** B. B. G., N. Y. B. G., L. I.
16. *Salix fragilis* L. **Crack Willow.** Kis. Pk., Pel. Pk., V. C. Pk.
17. *Salix alba* L. var. *vitellina* (L.) Koch. **Golden Willow.** B. B. G., Inw., Kis. Pk.
18. *SALIX BABYLONICA* L. **BABYLON WEeping WILLOW.** B. B. G., Pal., V. C. Pk.
19. *Salix discolor* Muhl. **Pussy Willow.** B. Ter., Kis. Pk., Pel. Pk.
20. *Salix sericea* Marsh. **Silky Willow.** Kis. Pk., V. C. Pk.
21. *Populus alba* L. **White Poplar.** Kis. Pk., N. Y. B. G., Pel. Pk.
22. *Populus tremuloides* Michx. **Aspen.** B. Ter., Pel. Pk., V. C. Pk.
23. *Populus grandidentata* Michx. **Large-tooth Aspen.** B. Ter. Inw., Pel. Pk., V. C. Pk.
24. *Populus deltoides* Marsh. **Eastern Cottonwood.** Pal.
- [25. *Populus nigra* L. var. *italica* Du Roi. **Lombardy Poplar.**] Commonly large + small capital
cult.
26. **Myrica carolinensis* Mill. **Bayberry.** Inw., L. I. and S. I.
27. *Juglans cinerea* L. **Butternut.** Inw., Pal., V. C. Park.
28. *Juglans nigra* L. **Black Walnut.** B. B. G., Inw., N. Y. B. G., Pal., Pel. Pk., Pros. Pk.
29. *Carya ovata* (Mill.) K. Koch. **Shagbark Hickory.** Kis. Pk., N. Y. B. G., Pal., Pel. Pk., V. C. Pk.
30. *Carya alba* (L.) K. Koch. **Mockernut Hickory.** B. Ter., Inw., N. Y. B. G., Pal., Pel. Pk., V. C. Pk.
31. *Carya glabra* (Mill.) Spach. **Pignut Hickory.** B. Ter., Inw., Kis. Pk., N. Y. B. G., Pal., V. C. Pk.
32. *Carya cordiformis* (Wang.) K. Koch. **Bitternut Hickory.** C. Pk., Inw., Kis. Pk., N. Y. B. G., Pal., Pel. Pk., V. C. Pk.
33. **Corylus americana* Walt. **Hazelnut.** C. Pk., V. C. Pk.
34. *Ostrya virginiana* (Mill.) K. Koch. **Hop Hornbeam.** C. Pk., Inw., N. Y. B. G., Pal., Pros. Pk.
35. *Carpinus caroliniana* Walt. **Blue Beech.** C. Pk., Inw., Kis. Pk., N. Y. B. G., Pal., Pros. Pk., V. C. Pk.
36. *CARPINUS BETULUS* L. **EUROPEAN HORNBEAM.** Common in Pros. Pk.
37. *Betula lenta* L. **Sweet Birch.** B. Ter., Inw., Kis. Pk., N. Y. B. G., Pal., Pros. Pk., V. C. Pk.
38. *Betula lutea* Michx. f. **Yellow Birch.** B. B. G., N. Y. B. G., V. C. Pk.
39. *Betula populifolia* Marsh. **Gray Birch.** B. Ter., Kis. Pk., N. Y. B. G., Pal., V. C. Pk.

40. *Betula papyrifera* Marsh. **Paper Birch.** Pros. Pk.
41. *BETULA PENDULA* Roth. **EUROPEAN BIRCH.** Commonly cultivated.
42. **Alnus rugosa* (Du Roi) Spreng. **Smooth Alder; Hazel Alder.**
B. Ter., Inw., Kis Pk., V. C. Pk.
43. *Fagus grandifolia* Ehrh. **Beech.** B. B. G., Inw., Kis. Pk., N. Y.
B. G., Pal., Pel. Pk., V. C. Pk.
44. *FAGUS SYLVATICA* L. **EUROPEAN BEECH.**
45. *FAGUS SYLVATICA* L. var. *PURPUREA* Ait. **COPPER BEECH.** Commonly
cultivated.
46. *FAGUS SYLVATICA* L. var. *INCISA* Hort. **CUT-LEAF BEECH.** Commonly
cultivated.
47. *Castanea dentata* (Marsh.) Borkh. **Chestnut.** B. Ter., Inw.,
Pal., V. C. Pk.
48. *Quercus alba* L. **White Oak.** B. Ter., C. Pk., Inw., Kis. Pk.,
N. Y. B. G., Pal., Pel. Pk., Pros. Pk., V. C. Pk.
49. *Quercus stellata* Wang. **Post Oak.** L. I., Pal.
50. *Quercus bicolor* Willd. **Swamp White Oak.** B. B. G., Kis. Pk.,
N. Y. B. G., Pal., Pel. Pk., V. C. Pk.
51. *Quercus montana* Willd. **Chestnut Oak.** B. Ter., Inw., Pal.
52. *QUERCUS ROBUR* L. **ENGLISH OAK.** B. B. G., Kis. Pk.
53. *Quercus borealis* Michx. **Red Oak.** B. Ter., B. B. G., C. Pk.,
Inw., Kis. Pk., N. Y. B. G., Pal., Pel. Pk., Pros. Pk., V. C. Pk.
54. *Quercus palustris* Muench. **Pin Oak.** B. Ter., B. B. G., C. Pk.,
Kis. Pk., N. Y. B. G., Pal., Pel. Pk., Pros. Pk.
55. *Quercus coccinea* Muench. **Scarlet Oak.** B. Ter., Inw., Pal.,
Pros. Pk.
56. *Quercus velutina* Lam. **Black Oak.** B. Ter., B. B. G., C. Pk.,
Inw., Kis. Pk., Pal., Pros. Pk., V. C. Pk.
57. *Quercus ilicifolia* Wang. **Bear or Scrub Oak.** L. I. and S. I.
58. *Quercus Phellos* L. **Willow Oak.** Pros. Pk. and S. I.
59. *Ulmus fulva* Michx. **Slippery Elm.** Inw., Kis. Pk., Pal., V. C.
Park.
60. *Ulmus americana* L. **American Elm.** B. Ter., B. B. G., C. Pk.,
Inw., Kis. Pk., N. Y. B. G., Pal., Pel. Pk., Pros. Pk., V. C. Pk.
61. *ULMUS PROCERA* Salisb. **ENGLISH ELM.** Pros. Pk.
62. *Celtis occidentalis* L. **Hackberry.** C. Pk., Inw., Kis. Pk., Pal.,
Pros. Pk., V. C. Pk.
63. *Broussonetia papyrifera* (L.) Vent. **Paper Mulberry.** Pal.,
Pros. Pk.
64. *Morus alba* L. **White Mulberry.** B. B. G., C. Pk., Inw., N. Y.
B. G., Pros. Pk.
65. *Morus rubra* L. **Red Mulberry.** Inw., Pal.

66. *Liriodendron Tulipifera* L. **Yellow Poplar; Tulip Tree.** C. Pk., Inw., Kis. Pk., N. Y. B. G., Pal., Pros. Pk., V. C. Pk.
67. **Berberis vulgaris* L. **Common Barberry.** B. B. G., N. Y. B. G.
68. **Berberis Thunbergii* DC. **JAPANESE BARBERRY.** B. B. G., N. Y. B. G., Kis. Pk.
69. *Sassafras variifolium* (Salisb.) Ktze. **Sassafras.** B. Ter., C. Pk., Inw., Kis. Pk., N. Y. B. G., Pal., Pel. Pk., Pros. Pk., V. C. Pk.
70. *Benzoin aestivale* (L.) Nees. **Spice Bush.** B. Ter., B. B. G., C. Pk., Inw., Kis. Pk., N. Y. B. G., Pal., Pel. Pk., Pros. Pk., V. C. Pk.
71. *Hamamelis virginiana* L. **Witch Hazel.** B. B. G., C. Pk., Inw., N. Y. B. G., Pal., V. C. Pk.
72. *Liquidambar Styraciflua* L. **Red Gum; Sweet Gum.** B. Ter., B. B. G., C. Pk., Kis. Pk., N. Y. B. G.
73. *Platanus occidentalis* L. **Sycamore; Buttonwood.** Inw., Pal., Pel. Pk., V. C. Pk.
74. *PLATANUS ORIENTALIS* L. **ORIENTAL PLANE.** C. Pk.
75. *PLATANUS ACERIFOLIA* Willd. **LONDON PLANE.** Commonly planted along streets.
76. *Malus pumila* Mill. **Common Apple.** Inw., Kis. Pk., V. C. Pk.
77. *Pyrus communis* L. **Pear.** Pel. Pk.
78. **Aronia arbutifolia* Elliott **Red Chokeberry.** B. Ter.
79. **Aronia melanocarpa* Elliott **Black Chokeberry.** B. Ter., Pal.
80. *SORBUS AUCUPARIA* L. **EUROPEAN MOUNTAIN ASH; ROWAN TREE.** B. B. G., N. Y. B. G.
81. *Amelanchier canadensis* (L.) Medic. **Serviceberry.** Inw., Pal., Pros. Pk., N. Y. B. G.
82. *Crataegus Oxyacantha* L. **English Hawthorn.** Pros. Pk.
83. **Rubus occidentalis* L. **Black Raspberry.** B. Ter., Inw., Pal., V. C. Pk.
84. **Rubus hispidus* L. **Swamp Dewberry.** B. Ter.
85. **Rubus villosus* Ait. **Dewberry.** B. Ter., Inw.
86. **Rubus Andrewsianus* Blanchard. **Andrews' Highbush Blackberry.** B. Ter., Inw., Pal., Pel. Pk., V. C. Pk.
87. **Rosa carolina* L. **Swamp Rose.** Kis. Pk., V. C. Pk.
88. *Prunus serotina* Ehrh. **Black Cherry.** B. Ter., C. Pk., Inw., Kis. Pk., N. Y. B. G., Pal., Pel. Pk., Pros. Pk., V. C. Pk.
89. *Prunus virginiana* L. **Choke Cherry.** B. B. G., Pros. Pk.
90. *Prunus avium* L. **Sweet Cherry.** Inw., Kis. Pk., Pal., Pel. Pk., Pros. Pk., V. C. Pk.
91. *Prunus persica* (L.) Stokes **Peach.** Inw., Pal.
92. *Gymnocladus dioica* (L.) Koch. **Coffee-tree.** Flushing, Pros. Pk.

93. *Gleditsia triacanthos* L. **Honey Locust.** B. B. G., C. Pk., Kis. Pk., Pal.
94. *Cladrastis lutea* (Michx. f.) Koch. **Yellowwood.** Pros. Pk.
95. *SOPHORA JAPONICA* L. **JAPAN PAGODA-TREE.** B. B. G., Pros. Pk.
96. **Amorpha fruticosa* L. **False Indigo; Indigo Bush.** B. B. G., Kis. Pk.
97. *Robinia Pseudoacacia* L. **Black Locust.** B. Ter., B. B. G., C. Pk., Inw., Kis. Pk., Pal., Pel. Pk., V. C. Pk.
- Ptelea 98. ~~Betula~~ *trifoliata* L. **Hoptree.** C. Pk., Kis., Pros. Pk.
99. *Ailanthus altissima* (Mill.) Swingle. **Ailanthus.** B. B. G., C. Pk., Inw., N. Y. B. G., Pal., Pel. Pk., Pros. Pk., V. C. Pk.
100. *Rhus typhina* L. **Staghorn Sumach.** Inw., Pal., V. C. Pk.,
101. **Rhus glabra* L. **Smooth Sumach.** Inw., Kis. Pk., Pal., Pel. Pk., V. C. Pk.
102. *Rhus copallina* L. **Dwarf Sumach.** B. Ter., Pel. Pk.
103. *Rhus vernix* L. **Poison Sumach.** B. Ter., Kis. Pk., V. C. Pk.
104. ***Rhus toxicodendron* L. **Poison Ivy.** B. Ter., B. B. G., C. Pk., Inw., Kis. Pk., N. Y. B. G., Pal., Pel. Pk., Pros. Pk., V. C. Pk.
105. *Ilex opaca* Ait. **Holly.** B. B. G., C. Pk.
106. **Ilex verticillata* (L.) Gray. **Common Winterberry; Black-alder.** B. Ter., Kis. Pk., V. C. Pk.
107. ***Celastrus scandens* L. **American Bittersweet.** N. Y. B. G.
108. *Acer saccharum* Marsh. **Sugar Maple.** Inw., N. Y. B. G., Pal., V. C. Pk.
109. *Acer platanoides* L. **Norway Maple.** B. B. G., C. Pk., Kis. Pk., N. Y. B. G., Pros. Pk.
110. *Acer saccharinum* L. **Silver Maple.** N. Y. B. G., Pal., Pros. Pk.
111. *Acer rubrum* L. **Red Maple.** B. Ter., C. Pk., Inw., Kis. Pk., N. Y. B. G., Pal., Pros. Pk., V. C. Pk.
112. *Acer Pseudoplatanus* L. **Sycamore Maple.** B. B. G., C. Pk., Kis. Pk., N. Y. B. G., Pros. Pk.
113. *ACER CAMPESTRE* L. **HEDGE MAPLE.** Pros. Pk.
114. *Acer Negundo* L. **Boxelder.** Kis. Pk., N. Y. B. G., Pros. Pk.
115. *ACER PALMATUM* Thunb. **JAPANESE MAPLE.** Kis. Pk.
116. *ACER JAPONICUM* Thunb. **FULLMOON MAPLE.** Kis. Pk.
117. *Aesculus Hippocastanum* L. **Horse-chestnut.** B. B. G., C. Pk., Kis. Pk., Pros. Pk., V. C. Pk.
118. ***Psedera quinquefolia* (L.) Greene. **Virginia Creeper.** B. Ter., Inw., Pal., Pel. Pk., V. C. Pk.
119. ***Vitis* spp. **Grapes.** Kis. Pk., S. I.
120. *Tilia glabra* Vent. **Basswood.** B. B. G., Inw., Kis. Pk., N. Y. B. G., Pal., Pel. Pk., Pros. Pk., V. C. Pk.

121. *Cornus florida* L. Dogwood. C. Pk., Inw., Kis. Pk., N. Y. B. G., Pal., Pel. Pk., Pros. Pk., V. C. Pk.
122. **Cornus Amomum* Mill. Kinnikinnik. V. C. Pk.
123. **Cornus paniculata* L'Her. Panicle Dogwood; Gray Dogwood. Pel. Pk., V. C. Pk.
124. *Cornus mas* L. CORNELIAN CHERRY. B. B. G., Pros. Pk.
125. *Nyssa sylvatica* Marsh. Black Gum; Sour Gum. B. Ter., C. Pk., Kis. Pk., N. Y. B. G., Pal., Pel. Pk., Pros. Pk., V. C. Pk. . . .
126. **Clethra ainifolia* L. Sweet Pepperbush. B. Ter., B. B. G., Kis. Pk., N. Y. B. G., Pros. Pk.
127. **Rhododendron viscosum* (L.) Torr. Swamp Azalea. B. Ter., N. Y. B. G.
128. **Rhododendron nudiflorum* (L.) Torr. Pinxterbloom. B. Ter., Pal., V. C. Pk.
129. *Kalmia latifolia* L. Mountain Laurel. B. B. G., N. Y. B. G.
130. **Lyonia ligustrina* (L.) DC. Male Berry. B. Ter.
131. **Gaylussacia baccata* (Wang.) C. Koch. Black Huckleberry. B. Ter.
132. **Vaccinium pennsylvanicum* Lam. Lowbush Blueberry. B. Ter.
133. **Vaccinium vacillans* Kalm. Dryland Blueberry. Inw., Pal., V. C. Pk.
134. **Vaccinium corymbosum* L. Highbush Blueberry. B. Ter., Kis. Pk., V. C. Pk.
135. *Fraxinus americana* L. White Ash. B. B. G., C. Pk., Inw., Kis. Pk., N. Y. B. G., Pal., Pel. Pk., Pros. Pk., V. C. Pk.
136. *Fraxinus pennsylvanica* Marsh. Red Ash. B. B. G., Inw., V. C. Pk.
137. ***Solanum Dulcamara* L. Bitter Nightshade. Kis. Pk.
138. *Paulownia tomentosa* (Thunb.) Steud. Royal Paulownia. Inw., N. Y. B. G., Pal., V. C. Pk.
139. *Catalpa bignonioides* Walt. Common Catalpa.
140. *Cephalanthus occidentalis* L. Buttonbush. B. Ter., Kis. Pk.
141. ***Lonicera japonica* Thunb. Japanese Honeysuckle. C. Pk., For. Pk., Inw., Kis. Pk., Pal.
142. **Viburnum acerifolium* L. Mapleleaf Viburnum. Inw., Pal., V. C. Pk.
143. **Viburnum dentatum* L. Arrowwood. B. Ter., Kis. Pk., Pal., Pel. Pk., V. C. Pk.
144. *Viburnum prunifolium* L. Blackhaw. C. Pk., Inw., Kis. Pk., Pal., Pel. Pk., V. C. Pk.
145. **Sambucus canadensis* L. American Elder. B. Ter., Inw., Kis. Pk., N. Y. B. G., Pal., Pel. Pk., Pros. Pk., V. C. Pk.
146. **Sambucus pubens* Michx. Red-berried Elder. Pal., Inw.

ARTHUR HARMOUNT GRAVES.

NOTICES

The Garden may be reached in the following ways: Flatbush Avenue trolley to Empire Boulevard; Franklin Avenue and Lorimer Street trolleys to Flatbush Avenue; St. John's Place trolley to Sterling Place and Washington Avenue; Ninth Avenue, Union Street, Vanderbilt Avenue, and Smith Street trolleys to Grand Army Plaza and Union Street; Brighton Beach Express, Broadway (B.M.T.) Subway to Prospect Park (north exit). From Pennsylvania Station, Manhattan, take Broadway-Seventh Avenue Subway to Eastern Parkway-Brooklyn Museum Station. From Grand Central Station, Manhattan, take Lexington Avenue Subway, changing at Nevins Street, Brooklyn, to Broadway-Seventh Avenue Subway, getting off at Eastern Parkway-Brooklyn Museum Station.

The Garden is open free to the public daily, from 8 a. m. until dark; on Sundays and holidays from 10 a. m. until dark. The Laboratory Building, containing the Library, Herbarium, and offices, is open daily (except Sundays), from 9 a. m. until 5 p. m. (Saturdays, 9-12). The Conservatories are open April 1-September 30, 10 a. m.-4:30 p. m. (Sundays, 2-4:30); October 1-March 31, 10 a. m.-4 p. m. (Sundays, 2-4).

Entrances—On Flatbush Avenue (1) near Empire Boulevard, and (2) near Mt. Prospect Reservoir; on Washington Avenue, (3) south to Eastern Parkway, and (4) near Empire Boulevard; on Eastern Parkway, (5) west of the Museum building.

The Street entrance to the Laboratory Building is at 1000 Washington Avenue, between Eastern Parkway and Empire Boulevard and opposite Crown Street.

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Telephone: 9-6173 Prospect. Mail address: Brooklyn Botanic Garden, Brooklyn, N. Y.

LEAFLETS

IMPORTANT HERBACEOUS PLANTS OF THE
GREATER NEW YORK REGION

This LEAFLET is a companion issue to that in which the list of important woody plants¹ of this region was recently published, and is intended primarily for the use of candidates for teaching licenses in High School Biology or for the license of First Assistant. The list has been prepared at the request of the committee on requirements appointed by the Board of Examiners, and it includes all the herbaceous species which candidates may be expected to know.

The Greater New York region, as here defined, is not restricted to the area within the geographic limits of the five boroughs, but includes such places in the immediate vicinity of the City as the Palisades of New Jersey and parts of Long Island. The scientific names used are those of Gray's "Manual of Botany," Edition 7.

For the most part, these plants are native or long established, but some of the commoner vegetables and flowers which have escaped from gardens or persist after cultivation, as well as a few strictly cultivated plants of unusual interest, are also included.

FERNS

1. *Polypodium vulgare*. Common Polypody. A common fern on ledges.
2. *Adiantum pedatum*. Maidenhair Fern. Rich wooded slopes.
3. *Pteris aquilina*. Common Brake. Dry woods.
4. *Polystichum acrostichoides*. Christmas Fern. An evergreen species in woods. The "dagger fern" used ornamentally in markets.
5. *Aspidium marginale*. Marginal Shield Fern. Grows with the previous species. Sori at margins of pinnules.
6. *Aspidium spinulosum* var. *intermedium*. Spinulose Shield Fern. The "fancy fern" of markets, common in woods northward.
7. *Dicksonia punctilobula*. Hay-Scented Fern. Pastures and borders of woods.
8. *Onoclea sensibilis*. Sensitive Fern. Moist places. One of the earliest plants to show effects of frost.

¹Graves, Arthur H. Important woody plants—trees, shrubs, and woody climbers—of Greater New York. Brooklyn Bot. Gard. Leaflets, Series XIX, No. 2-3. 1931.

9. *Osmunda regalis*. Flowering or Royal Fern. Chiefly along brooks.
10. *Osmunda Claytoniana*. Interrupted Fern. Moist woods.
11. *Osmunda cinnamomea*. Cinnamon Fern. Swamps, and along brooks.

HORSETAILS

12. *Equisetum arvense*. Common Horsetail. Abundant on roadsides. The fertile spikes appear on railroad embankments early in the spring.
13. *Equisetum hyemale* var. *affine*. Scouring Rush. Occasional in moist places. Palisades.

CLUB MOSSES

14. *Lycopodium obscurum* var. *dendroideum*. Tree Club Moss. Woods.
15. *Lycopodium complanatum* var. *flabelliforme*. Ground Pine. The commonest species, widely used for Christmas greens. Woods.

SELAGINELLA

16. *Selaginella apus*. A tiny moss-like plant, common at the edge of meadows.

ANGIOSPERMS

17. *Typha latifolia*. Common Cat-tail. Wet places.
18. *Typha angustifolia*. Narrow-leaved Cat-tail. Chiefly at borders of salt marshes.
19. *Sparganium eurycarpum*. Bur-reed. Margins of streams.
20. *Sagittaria latifolia*. Arrow-head. Wet places.
21. *Alisma Plantago-aquatica*. Water Plantain. Ditches and pools.
22. *Elodea canadensis*. Water-weed. Ponds and streams.
23. *Arisaema triphyllum*. Indian Turnip. Jack-in-the-Pulpit. Moist woods and swamps.
24. *Symplocarpus foetidus*. Skunk Cabbage. Swamps.
25. *Acorus Calamus*. Sweet Flag. Not uncommon in wet meadows.
26. *Lemna minor*. Duckweed. Floating on the surface of ponds.
27. *Tradescantia virginiana*. Tradescantia. Occasional in low woods.
28. *Commelina communis*. Day-flower. A weed in dooryards, etc.
29. *Pontederia cordata*. Pickerel-weed. Shallow water.
30. *Veratrum viride*. False Hellebore. Along brooks.
31. *Uvularia perfoliata*. Bellwort. Rich woods.
32. *Allium vineale*. Field Garlic. Meadows.
33. *Hemerocallis fulva*. Common Day Lily. Roadsides, escaped from gardens.
34. *Lilium philadelphicum*. Wood Lily. Dry woods.
35. *Lilium canadense*. Wild Yellow Lily. Meadows.

(No. 2-3. April 22, 1931)

36. *Lilium superbum*. Turk's-cap Lily. Low places near the coast.
37. *Erythronium americanum*. Dog's-tooth Violet. Low woods.
38. *Ornithogalum umbellatum*. Star of Bethlehem. Escaped from gardens.
39. *Asparagus officinalis*. Asparagus. Escaped from gardens.

Number 25, page 3, should read: *POPULUS NIGRA* L. var. *ITALICA*.

LOMBARDY POPLAR.

Number 98, page 6, should read: *Ptelea*.

- amosa*. False Solomon's Seal. Thickets.
- canadense*. False Lily-of-the-Valley. Woods.
- biflorum*. Solomon's Seal. Rocky hillsides.
- ajalis*. Lily-of-the-Valley. Escaped.
- niana*. Indian Cucumber-root. Woods.
- um*. Purple Trillium. Moist woods.
- ifolia*. Common Green Brier. Thickets, especially regions.
- .* Blue Flag. Wet places.
- angustifolium*. Blue-eyed Grass. Meadows and s.
- caule*. Lady's Slipper. Dry or moist woods.
- nua*. Ladies' Tresses. Meadows.
- maculata*. Coral Root. Woods.
- ilus*. Hops. Waste places.
- .* Nettle. Waste places.
- ense*. Wild Ginger. Rich woods.
- macrophylla*. Dutchman's Pipe. Often grown on Wild southward.
- .* Yellow Dock. Common in waste grounds.
- lla*. Sheep Sorrel. Fields.
- culare*. Knotweed. A weed in lawns.
- entale*. Prince's Feather. Escaped from gardens.
- album*. Pigweed. Waste places.
- opaea*. Glasswort. Forming red patches in salt i the autumn.
- etroflexus*. Green Amaranth. A weed in culti-s and vacant lots.
- andra*. Pokeweed. Woods.
- .* Common Chickweed. A common weed.

55. *Cerastium vulgatum*. Mouse-ear Chickweed. A weed in fields.
66. *Silene latifolia*. Bladder Campion. Waste places.
67. *Silene pennsylvanica*. Wild Pink. Gravelly banks.
68. *Dianthus barbatus*. Sweet William. Escaped from gardens.
69. *Claytonia virginica*. Spring Beauty. Moist woods.
70. *Nymphaea advena*. Yellow Pond Lily. Lakes and streams.
71. *Castalia odorata*. Water Lily. Lakes.
72. *Nelumbo nucifera*. Lotus. Cultivated.

9. *Osmunda regalis*. Flowering or Royal Fern. Chiefly along brooks.
10. *Osmunda Claytoniana*. Interrupted Fern. Moist woods.
11. *Osmunda cinnamomea*. Cinnamon Fern. Swamps, and along brooks.

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15. *Lycopodium complanatum* var. *flabelliforme*. commonest species, widely used for Mosses.

SELAGINELLA

16. *Selaginella apus*. A tiny moss-like plant, common in meadows.

ANGIOSPERMS

17. *Typha latifolia*. Common Cat-tail. Wet places.
18. *Typha angustifolia*. Narrow-leaved Cat-tail. of salt marshes.
19. *Sparganium eurycarpum*. Bur-reed. Marginal.
20. *Sagittaria latifolia*. Arrow-head. Wet places.
21. *Alisma Plantago-aquatica*. Water Plantain.
22. *Elodea canadensis*. Water-weed. Ponds and swamps.
23. *Arisaema triphyllum*. Indian Turnip. Jack-potatoes and swamps.
24. *Symplocarpus foetidus*. Skunk Cabbage. Sedges.
25. *Acorus Calamus*. Sweet Flag. Not uncommon.
26. *Lemna minor*. Duckweed. Floating on the water.
27. *Tradescantia virginiana*. Tradescantia. Occasional.
28. *Commelina communis*. Day-flower. A weed.
29. *Pontederia cordata*. Pickerel-weed. Shallow water.
30. *Veratrum viride*. False Hellebore. Along brooks.
31. *Uvularia perfoliata*. Bellwort. Rich woods.
32. *Allium vineale*. Field Garlic. Meadows.
33. *Hemerocallis fulva*. Common Day Lily. Roadsides, escaped from gardens.
34. *Lilium philadelphicum*. Wood Lily. Dry woods.
35. *Lilium canadense*. Wild Yellow Lily. Meadows.

36. *Lilium superbum*. Turk's-cap Lily. Low places near the coast.
37. *Erythronium americanum*. Dog's-tooth Violet. Low woods.
38. *Ornithogalum umbellatum*. Star of Bethlehem. Escaped from gardens.
39. *Asparagus officinalis*. Asparagus. Escaped from gardens.
40. *Smilacina racemosa*. False Solomon's Seal. Thickets.
41. *Maianthemum canadense*. False Lily-of-the-Valley. Woods.
42. *Polygonatum biflorum*. Solomon's Seal. Rocky hillsides.
43. *Convallaria majalis*. Lily-of-the-Valley. Escaped.
44. *Medeola virginiana*. Indian Cucumber-root. Woods.
45. *Trillium erectum*. Purple Trillium. Moist woods.
46. *Smilax rotundifolia*. Common Green Brier. Thickets, especially in sandy regions.
47. *Iris versicolor*. Blue Flag. Wet places.
48. *Sisyrinchium angustifolium*. Blue-eyed Grass. Meadows and woodlands.
49. *Cypripedium acaule*. Lady's Slipper. Dry or moist woods.
50. *Spiranthes cernua*. Ladies' Tresses. Meadows.
51. *Corallorrhiza maculata*. Coral Root. Woods.
52. *Humulus Lupulus*. Hops. Waste places.
53. *Urtica dioica*. Nettle. Waste places.
54. *Asarum canadense*. Wild Ginger. Rich woods.
55. *Aristolochia macrophylla*. Dutchman's Pipe. Often grown on trellises. Wild southward.
56. *Rumex crispus*. Yellow Dock. Common in waste grounds.
57. *Rumex acetosella*. Sheep Sorrel. Fields.
58. *Polygonum aviculare*. Knotweed. A weed in lawns.
59. *Polygonum orientale*. Prince's Feather. Escaped from gardens.
60. *Chenopodium album*. Pigweed. Waste places.
61. *Salicornia europaea*. Glasswort. Forming red patches in salt marshes in the autumn.
62. *Amaranthus retroflexus*. Green Amaranth. A weed in cultivated fields and vacant lots.
63. *Phytolacca decandra*. Pokeweed. Woods.
64. *Stellaria media*. Common Chickweed. A common weed.
65. *Cerastium vulgatum*. Mouse-ear Chickweed. A weed in fields.
66. *Silene latifolia*. Bladder Campion. Waste places.
67. *Silene pennsylvanica*. Wild Pink. Gravelly banks.
68. *Dianthus barbatus*. Sweet William. Escaped from gardens.
69. *Claytonia virginica*. Spring Beauty. Moist woods.
70. *Nymphaea advena*. Yellow Pond Lily. Lakes and streams.
71. *Castalia odorata*. Water Lily. Lakes.
72. *Nelumbo nucifera*. Lotus. Cultivated.

73. **Ranunculus fascicularis.** Early Crowfoot. An early species in open woods.
74. **Ranunculus bulbosus.** Bulbous Buttercup. Abundant in fields; a native of Europe.
75. **Ranunculus acris.** Tall Buttercup. Abundant in meadows; a native of Europe.
76. **Thalictrum dioicum.** Early Meadow Rue. Rocky woods.
77. **Thalictrum polygamum.** Tall Meadow Rue. Wet places.
78. **Anemonella thalictroides.** Rue Anemone. Woods.
79. **Hepatica triloba.** Hepatica. Woods.
80. **Anemone quinquefolia.** Wood Anemone. Moist woods.
81. **Anemone cylindrica.** Thimbleweed. Rocky woods.
82. **Clematis virginiana.** Clematis. River banks, etc.
83. **Caltha palustris.** Marsh Marigold. Wet meadows and swamps.
84. **Aquilegia canadensis.** Columbine. Rocky banks.
85. **Cimicifuga racemosa.** Black Snakeroot. Rich woods.
86. **Actaea rubra.** Red Baneberry. Rich woods.
87. **Actaea alba.** White Baneberry. In dryer woods than the preceding species.
88. **Menispermum canadense.** Moonseed. River banks. Palisades.
89. **Podophyllum peltatum.** May Apple. Rich woods.
90. **Caulophyllum thalictroides.** Blue Cohosh. Rich woods.
91. **Sanguinaria canadensis.** Bloodroot. Rich open woods.
92. **Chelidonium majus.** Celandine. Abundant in moist places about abandoned houses, etc.
93. **Papaver somniferum.** Opium Poppy. Waste places; gardens.
94. **Papaver Rhoeas.** Corn Poppy. The common red poppy. Cultivated.
95. **Corydalis sempervirens.** Pale Corydalis. Rocky places.
96. **Lobularia maritima.** Sweet Alyssum. Cultivated.
97. **Lepidium virginicum.** Wild Peppergrass. Roadsides.
98. **Raphanistrum sativus.** Radish. Escaped from gardens.
99. **Brassica arvensis.** Field mustard. A weed in fields.
100. **Brassica nigra.** Black mustard. Roadsides and waste places. Pedicels appressed; seeds black.
101. **Brassica Rapa.** Turnip. Persisting after cultivation.
102. **Brassica oleracea.** Cabbage. Escaped from cultivation.
103. **Barbarea vulgaris.** Winter Cress. Yellow flowered, common in ditches.
104. **Radicula Nasturtium-aquaticum.** Water Cress. Brooks and ditches.
105. **Dentaria diphylla.** Toothwort. Low woods.
106. **Dentaria laciniata.** Cut-leaved Toothwort. Rich woods.
107. **Cardamine pennsylvanica.** Bitter Cress. Along brooks.

108. *Cleome spinosa*. Spider-flower. Introduced from the tropics.
109. *Sarracenia purpurea*. Pitcher-plant. Peat bogs.
110. *Drosera rotundifolia*. Sun-dew. Peat bogs and moist, sandy ground.
111. *Sedum purpureum*. Live-for-ever. Escaped from cultivation.
112. *Sempervivum tectorum*. House-leek. Basal rosettes very thick; cultivated and sometimes escaped.
113. *Saxifraga virginensis*. Early Saxifrage. Exposed rocks.
114. *Tiarella cordifolia*. False Mitrewort. Rich woods.
115. *Mitella diphylla*. Bishop's Cap. Rich woods.
116. *Fragaria virginiana*. Wild Strawberry. Hillsides.
117. *Potentilla argentea*. Silvery Cinquefoil. Dry fields.
118. *Potentilla canadensis*. Canadian Cinquefoil. Sandy soil.
119. *Agrimonia gryposepala*. Agrimony. Thickets.
120. *Cassia Chamaecrista*. Partridge Pea. Sandy fields.
121. *Baptisia tinctoria*. Wild Indigo. Dry woods.
122. *Lupinus perennis*. Wild Lupine. Sandy soil.
123. *Trifolium arvense*. Rabbit-foot Clover. Roadsides in sandy soil.
124. *Trifolium pratense*. Red Clover. Meadows.
125. *Trifolium repens*. White Clover. Roadsides.
126. *Trifolium hybridum*. Alsike Clover. Flowers pink, fragrant. Roadsides.
127. *Trifolium agrarium*. Yellow Clover. Fields.
128. *Medicago sativa*. Alfalfa. Escaped.
129. *Desmodium* sp. Tick Trefoil.
130. *Lespedeza* sp. Bush Clover.
131. *Vicia Cracca*. Blue Vetch. Common at borders of fields.
132. *Apios tuberosa*. Wild Bean. Thickets.
133. *Amphicarpa monoica*. Hog Peanut. Subterranean pods ripening a single large edible seed. A small twining plant in woodlands.
134. *Oxalis corniculata*. Yellow Wood Sorrel. A common weed.
135. *Geranium maculatum*. Wild Geranium. Open woods and fields.
136. *Ricinus communis*. Castor-oil Plant. Cultivated.
137. *Malva rotundifolia*. Common Mallow, Cheeses. Cultivated ground.
138. *Hibiscus Moscheutos*. Swamp Rose Mallow. Marshes.
139. *Hypericum perforatum*. Common St. John's-wort. A common weed in fields.
140. *Viola pedata*. Bird's-foot Violet. Sandy soil.
141. *Viola* sp. Blue Violet.
142. *Viola pubescens*. Downy Yellow Violet. Rich woods.
143. *Viola pallens*. Sweet White Violet. Swamps and along brooks.
144. *Rhexia virginica*. Meadow Beauty. Sandy swamps.

145. *Epilobium angustifolium*. Fireweed. In burned woods.
146. *Oenothera biennis*. Evening Primrose. Waste places.
147. *Aralia nudicaulis*. Wild Sarsaparilla. Woods.
148. *Panax trifolium*. Dwarf Ginseng. Rich woods.
149. *Osmorhiza longistylis*. Sweet Cicely. Rich woods.
150. *Cicuta maculata*. Water Hemlock. Along brooks. Poisonous.
151. *Zizia aurea*. Golden Alexanders. Meadows.
152. *Pastinaca sativa*. Parsnip. Escaped.
153. *Daucus Carota*. Carrot, Queen Anne's Lace. Fields.
154. *Monotropa uniflora*. Indian Pipe. Rich woods.
155. *Epigaea repens*. Trailing Arbutus. Woods or sand plains.
156. *Gaultheria procumbens*. Wintergreen. Woods and clearings.
157. *Limonium carolinianum*. Sea Lavender. Salt marshes.
158. *Lysimachia quadrifolia*. Four-leaved Loosestrife. Common in woods.
159. *Trientalis americana*. Star Flower. Woods.
160. *Gentiana crinita*. Fringed Gentian. Fields.
161. *Apocynum cannabinum*. Indian Hemp. Sandy soil, mostly near streams.
162. *Asclepias tuberosa*. Butterfly-weed. Dry fields; flowers bright orange.
163. *Asclepias syriaca*. Common Milk-weed. Fields.
164. *Convolvulus sepium*. Hedge Bindweed. Thickets.
165. *Cuscuta* sp. Dodder.
166. *Nepeta Cataria*. Catnip. Near dwellings.
167. *Nepeta hederacea*. Ground Ivy. Near towns.
168. *Prunella vulgaris*. Heal-all. Woods and fields.
169. *Mentha* sp. Mint.
170. *Monarda didyma*. Bee Balm. Escaped from gardens.
171. *Solanum Dulcamara*. Bittersweet. Flowers purple, fruit orange. Thickets.
172. *Datura Stramonium*. Jimson Weed. Waste grounds.
173. *Verbascum Thapsus*. Common Mullein. Fields, gravelly banks.
174. *Verbascum Blattaria*. Moth Mullein. Roadsides. Palisades.
175. *Linaria vulgaris*. Butter-and-eggs. Roadsides.
176. *Pentstemon* sp. Pentstemon. Open woods and fields.
177. *Chelone glabra*. Turtlehead. Wet meadows.
178. *Mimulus ringens*. Monkey Flower. Wet places.
179. *Gerardia tenuifolia*. Slender Gerardia. Woods.
180. *Pedicularis canadensis*. Wood Betony. Dry woods.
181. *Epifagus virginiana*. Beech-drops. Parasitic on roots of beech trees.
182. *Plantago major*. Common Plantain. A common weed.

183. *Plantago lanceolata*. Rib Grass, English Plantain. Fields.
184. *Mitchella repens*. Partridge Berry. Woods.
185. *Houstonia caerulea*. Bluets. Fields and moist grassy places.
186. *Cucurbita maxima*. Squash. Escaped.
187. *Lobelia cardinalis*. Cardinal Flower. Along streams.
188. *Eupatorium purpureum*. Joe-Pye Weed. Low ground.
189. *Eupatorium perfoliatum*. Boneset. Low ground.
190. *Solidago* sp. Goldenrod.
191. *Aster novae-angliae*. New England Aster. Rays violet-purple; often cultivated.
192. *Erigeron pulchellus*. Robin's Plantain. Moist roadsides.
193. *Erigeron annuus*. Daisy Fleabane. Fields.
194. *Antennaria* sp. Ladies' Tobacco. Dry woods and fields.
195. *Ambrosia artemisiifolia*. Ragweed. Roadsides. The chief cause of hay fever.
196. *Ambrosia trifida*. Great Ragweed. Rich soil. A cause of hay fever.
197. *Xanthium* sp. Cocklebur. Waste places. A cause of hay fever.
198. *Rudbeckia hirta*. Black-eyed Susan. Fields.
199. *Helianthus annuus*. Common Sunflower. In cultivation.
200. *Bidens* sp. Beggar-ticks, Bur Marigold. Wet places.
201. *Galinsoga parviflora*. Galinsoga. A common weed.
202. *Achillea Millefolium*. Common Yarrow. Roadsides.
203. *Chrysanthemum Leucanthemum* var. *pinnatifidum*. Daisy. Fields.
204. *Tanacetum vulgare*. Tansy. Roadsides.
205. *Tussilago Farfara*. Coltsfoot. Wet places and along brooks. The first flower to appear in the spring.
206. *Senecio aureus*. Golden Ragwort. Wet meadows and swamps.
207. *Arctium Lappa*. Burdock. Waste places.
208. *Cichorium Intybus*. Chicory. Roadsides.
209. *Leontodon autumnale*. Fall Dandelion. Roadsides and fields.
210. *Taraxacum officinale*. Dandelion. A common weed.
211. *Prenanthes* sp. Lion's-foot. Woods.
212. *Hieracium aurantiacum*. Devil's Paint-brush, Orange Hawk-weed. Fields.

HENRY K. SVENSON.

NOTICES

The Garden may be reached in the following ways: Flatbush Avenue trolley to Empire Boulevard; Franklin Avenue or Lorimer Street trolleys to Flatbush Avenue; St. John's Place trolley to Sterling Place and Washington Avenue; Ninth Avenue, Union Street, Vanderbilt Avenue, or Smith Street trolleys to Grand Army Plaza and Union Street; Brighton Beach Express, Broadway (B.M.T.) Subway to Prospect Park (north exit). From Pennsylvania Station, Manhattan, take Broadway-Seventh Avenue Subway to Eastern Parkway-Brooklyn Museum Station. From Grand Central Station, Manhattan, take Lexington Avenue Subway, changing at Nevins Street, Brooklyn, to Broadway-Seventh Avenue Subway, getting off at Eastern Parkway-Brooklyn Museum Station.

The Garden is open free to the public daily, from 8 a. m. until dark; on Sundays and holidays from 10 a. m. until dark. The Laboratory Building, containing the Library, Herbarium, and offices, is open daily (except Sundays), from 9 a. m. until 5 p. m. (Saturdays, 9-12). The Conservatories are open April 1-September 30, 10 a. m.-4:30 p. m. (Sundays, 2-4:30); October 1-March 31, 10 a. m.-4 p. m. (Sundays, 2-4). **The Japanese Garden** is open every day from 11 a. m. until dusk; on Sundays and holidays from 1 p. m. until dusk. **The Rose Garden** is open from 9 a. m. to 5 p. m. on weekdays. It is closed on Sundays and holidays.

Entrances—On Flatbush Avenue (1) near Empire Boulevard, and (2) near Mt. Prospect Reservoir; on Washington Avenue, (3) south of Eastern Parkway, and (4) near Empire Boulevard; on Eastern Parkway, (5) west of the Museum building.

The Street entrance to the Laboratory Building is at 1000 Washington Avenue, between Eastern Parkway and Empire Boulevard and opposite Crown Street.

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BROOKLYN BOTANIC GARDEN

LEAFLETS

SERIES XIX

BROOKLYN, N. Y., OCTOBER 21, 1931

No. 6

NOVEMBER IN YOUR GARDEN

**FALL TREATMENT OF GLADIOLUS, DAHLIAS,
CANNAS, HOUSEPLANTS: "GRUB-PROOFING" LAWNS:
PLANTING OF DECIDUOUS TREES AND SHRUBS.**

At this time of the year we are concerned with the care of those plants that will not survive the winter out-of-doors in our climate.

Gladiolus. As soon as the foliage has turned brown or as soon as it has been killed with frost, the gladiolus corms should be dug up and left for a few hours to dry before bringing them indoors. When the foliage is completely dried, it may be removed from the corms, and the latter stored in paper bags, if only a few are in question, or in shallow wooden trays if a large number have to be cared for. If you desire to increase your stock of these plants, the cormels that are found congregating around the base of the large corm may be saved separately and planted out the following year. When storing gladiolus, it is a good plan to shake tobacco dust amongst the corms. This will tend to prevent attacks by sucking insects. The corms should be stored in a cool, dry place and protected from mice.

Dahlias. When frost has blackened the foliage, the plants should be cut down to within 6" of the ground and the tubers dug up. If possible, leave them exposed to the sunshine for a few hours in order to dry off the surplus moisture. The tubers may be stored over winter by placing them in a cool cellar where the temperature does not fall below freezing. They may be protected from excessive drying out by wrapping in newspapers or by placing them in boxes and covering them with sand or peat moss.

The tubers of the Madeira Vine, Elephants' Ears, and the thick fleshy roots of Four O'Clocks may be dug up and stored in the same way as Dahlias.

Cannas. When the leaves are killed with frost, cut them down to the ground and dig up the roots leaving a fair amount of soil adhering to them. These roots should be placed in shallow boxes and stored where the air is moist and cool. At the Botanic Garden we store them under the benches in the cool greenhouses. It is not

necessary or desirable to water them during the winter as this may start them into growth prematurely.

House Plants. Plants growing in the open ground that are intended for use as house plants should be dug up and potted before the foliage has been injured by frost. Such plants as Begonia, Geranium, English Ivy, and Poinsettia may be used in this way. When digging them up, obtain as many roots as possible, pot them firmly, water thoroughly, and keep the plants shaded until they have recovered from the shock brought about by root disturbance. Such plants as Geranium may be cut back and the pieces cut off inserted as cuttings. All of these plants will require shading for a few days until new root action takes place.

Watering. At the time of writing, October 21, 1931, the ground is extremely dry. If we do not have ample rains shortly, it will be necessary to water evergreens if they are to come through the winter in good condition. If you have any doubts with regard to the moisture of the soil about the roots of these evergreens, obtain a cheap auger, about two feet long, screw it into the ground for its whole length, and then pull it out. The soil adhering to the lower portion of the auger will be indicative of the moisture conditions at that depth.

Hardy, spring-flowering bulbs may be planted out-of-doors until such time that the ground becomes frozen.

Planting of trees, shrubs, and herbaceous plants will soon be in full swing. Almost all of the deciduous trees and shrubs are successful when planted at this time. Such kinds as Oak, Beech, Birch, and Magnolia are perhaps better left until the spring. The same is true of many of the evergreens. Planting during the present abnormally dry season will necessitate extra precautions with regard to watering, if success is to be attained.

Japanese and Oriental Beetles. Those who have had trouble with the larvae of the above named pests, which are very fond of feeding on the roots of lawn grasses, thus destroying the lawn, might well "grub proof" their lawns at this season. This is done by an application of lead arsenate at the rate of 5 lbs. to each 1,000 square feet. In order to facilitate application, the lead arsenate should be mixed with about 1 bushel of finely sifted moist soil before it is applied to the surface of the ground. After application, it should be lightly raked into the surface of the lawn. The arsenate of lead may be applied at any time except when the soil is frozen or muddy.

MONTAGUE FREE.

GREEN ROSE NOW IN FLOWER AT THE BROOKLYN BOTANIC GARDEN

To expert Rosarians a green rose is nothing new. The variety (*viridiflora*) was introduced as far back as 1865, and is well known to all who possess a thorough grounding in rose lore. And yet, to the laymen—to those whose time and interests have been occupied with other things—the concept “green rose” may seem almost as difficult to visualize as that of a blue rose. All doubters, however, can easily have their misgivings set at rest by a visit to the Rose Garden of the Brooklyn Botanic Garden, where the green rose is burgeoning and flowering in its own quiet way. The plants, bearing a goodly number of their curious flowers, have been on view for several weeks in the Rose Garden, and are accompanied by the label *Rosa chinensis viridiflora*. The visitor who expects something spectacular will be disappointed, since the flowers resemble more than anything else the leafy proliferations often developing in some plants, due to the stings of gall insects. But close examination convinces one that this is a real flower with a perfectly normal five-parted calyx beneath, but with petals, stamens, and pistils all replaced by narrow, green, leaf-like structures, veined and even serrated on their edges like the rose leaves themselves, the whole flower being about an inch and one-half in diameter. Occasionally these leaves are slightly tinged with crimson, as if regretting their fall from grace to their present lowly phyllomaniac condition, for the plant teratologists class this kind of abnormality under the heading “Phyllomania.” Metamorphosis, or rather reversion, of petals, stamens, and pistils into green, leaf-like forms, is however, to be expected, and is excellent evidence of the foliar derivation of these organs.

GORDONIA, THE “LOST TREE,” BLOOMS AT THE BROOKLYN BOTANIC GARDEN

For more than 140 years *Gordonia Alatomaha*, a remarkably handsome tree belonging to the Tea or Camellia Family, has been lost. During this long period botanists have searched in vain the region of the Altamaha River, Georgia, where John Bartram, the distinguished early American botanist and horticulturist, first saw the tree in 1765. William Bartram, his son, twice revisited the locality—the last time in 1778. Finally Dr. Moses Marshall saw the tree growing in its native haunts in 1790, but since then it has been lost to view. Possibly no plants now exist in a wild state. All of the individuals now to be found in parks and gardens have been derived from the original specimens collected by the Bartrams and by Marshall.

The specimens at the Brooklyn Botanic Garden will be found not far from the walk bounding the experimental plot. Although they have been growing at the Garden only three seasons, and were very small when they were set out in May, 1929, some are now nearly six feet high. During the past month they have been particularly ornamental by reason of their large, white petalled flowers, much like those of the Camellia, a nearly related genus. The dark green, glossy leaves make

the tree an attractive one throughout the year, and now most of them have taken on a crimson color, of a shade similar to the autumn coloration of *Nyssa sylvatica*, the Pepperidge or Sour Gum.

Gordonia Alatomaha is a particularly valuable ornamental species because of its late blooming flowers, coming at a time when blooms are scarce. Commencing in September it often flowers throughout October, or until a hard frost comes. North of Connecticut it is said to be not entirely hardy, and in cold winters may be killed back to the ground. However, it shoots up the next year and may even bear flowers on the new shoots. To guard against chances of winter injury the plants at the Garden are protected during the cold weather by slanting frames made of wooden slats and packed with loose straw or cornstalks.

Although usually a low, spreading, shrubby tree with a maximum height of thirty feet, it has been known to attain a height of fifty feet near Philadelphia. Although known botanically as *Gordonia Alatomaha*, the Bartrams because of its unusual beauty, thought fit to christen it "Franklinia," in honor of their friend and neighbor, Benjamin Franklin, and Franklinia is now used as its common name.

THE HARDY CHRYSANTHEMUMS AT THE GARDEN

The shortening days and cooler nights are signals for the chrysanthemums to begin their annual flower show, for which they have long been making extensive preparations. It is the last big floral display of the year at the Brooklyn Botanic Garden, but as to variety of colors and abundance of blooms by no means the least. The plants will be found in their accustomed place near the walk south of the Rock Garden, the named varieties as usual in two parallel beds bordering the walk. Perhaps due to the abundance of sunny weather this year, an unusually large number of buds have been formed. A single plant of Quinola—a prolific variety, to be sure—was estimated to have over 600 buds and flowers.

Among the handsomest of the named varieties are Lillian Doty, a pink, quilled sort whose plant grows as high as five feet, and White Doty, similar, but of a cream color. Their delicate coloring and perfection in every detail are remarkable. The well known russet shades, such as those of Margaret M. Wanner and A. Barham, are always pleasing. Of the pompon type—those little, button-like fellows—Aurial, a light lemon yellow, and Quinola, of a deeper golden hue, are worthy representatives. Bright Eyes, Candida, and Yellow Frost are among the later varieties which will probably be in flower well up to the end of November.

In the transverse bed south of the named varieties are various unnamed dwarf sorts; some of these being seedlings, and some grown from cuttings selected from last year's seedlings. Although these make a most pleasing ensemble, careful inspection of the individual flowers will reveal slight flaws: on this account they have remained nameless.

ARTHUR HARMOUNT GRAVES.

BROOKLYN BOTANIC GARDEN

LEAFLETS

SERIES XIX

BROOKLYN, N. Y., NOVEMBER 18, 1931

No. 7-9

FORMS AND FUNCTIONS OF LEAVES*

This LEAFLET is prepared primarily for the assistance of teachers and students of botany and biology who visit the Brooklyn Botanic Garden. It contains brief accounts of most of the various forms and functions of leaves and leaf-like structures in seed plants, using as illustrations the living plants in the conservatories and outdoor plantations of the Garden.

The study of the form and structure of plants and plant organs is called *morphology* (Greek *morphe*—form): that of the functions—

**Morphology and
Physiology.**

i. e. what the organs do—how they “work,” is called *physiology* (Greek *physis*—nature). The

evolution of structures is known as their *morphogenesis* (Greek *genesis*—beginning). In accordance with the principles of evolution, new structures arise through variations (or mutations) from older types. The function or functions which such new structures may perform in a given environment is determined by their nature and by their location on the plant. In the course of the struggle for existence and the survival of the fittest, structures which are *seriously* disadvantageous to an organism are eliminated through the gradual dying out of the individuals in which they appear. If they are neither advantageous nor disadvantageous, but only of indifferent value to the organism, they may be retained.

For these reasons it is erroneous to assume, as is so often done, that all organs or structures in plants or animals necessarily perform some

**Not all organs or
structures
necessarily “good
for something.”**

helpful function. In many cases, like the human appendix, or the last four vertebrae (*coccyx*) forming an extension at the base of the human spinal column, they are simply remnants of or-

gans which in past ages were functional, but now, after countless generations, are only atrophied reminiscences of their former condition. Other structures, also, evidently arise from time to time in the process of evolution, through variation, bringing no harm to the organism, and they may even increase in size in successive generations. These useless structures, in many cases at least, may be linked up, in the inheritance complex, with the parallel development of some structure that is proving advantageous in the struggle for existence.

*This LEAFLET is a reprint of Number 9-10, Series XIV, with revision and additions.

Although everyone knows what a green foliage leaf is, there are many structures in plants very unlike an ordinary leaf in appearance, which, however, are really of leaf-like nature, or, as the botanist says, are "morphologically" leaves.

What constitutes a "leaf?"

This does not necessarily mean that at former evolutionary stages they were foliage leaves, but does mean that their manner of origin, their position with regard to other parts of the plant, as well as other characters, correspond to those of all leaf structures. Leaves arise from the outer tissues of the stem, and originate as slight lateral swellings (*primordia*) near the base of the growing point (*vegetative cone*) of the stem. They are developed in *acropetal succession*, that is, in regular order, the youngest always toward the apex of the stem. Moreover, they have a limited growth, i. e., develop to a certain size and then stop. There is no growing point composed of cells capable of continual growth and division, as in stems and roots. Again, except in some instances, (e. g. Bryophyllum and Begonia) leaf structures do not themselves produce buds, i. e., stems and leaves (shoots), nor roots. As a general rule, buds develop on the stem at the leaf axils and these are the places of formation of the ordinary lateral buds of seed plants, the terminal bud appearing, of course, at the end of the stem. We may sum up the characters of leaves as follows:

1. Borne on stems.
2. Originate from outer stem tissues near the base of the growing point of the stem.
3. Develop in acropetal succession.
4. Have limited growth.
5. Do not produce buds or roots but *may* show buds in their axils.

I. TYPICAL FOLIAGE LEAVES

1. *Form.* The kind of leaf of most common occurrence in the higher plants is the "foliage" leaf, composed of three main parts: *blade*, the thin, green, flat, expanded portion; *petiole*, the stalk, extending from the base of the blade down to the stem of the plant; and *stipules*, a pair of leaf-like growths on opposite sides of the petiole and at its base. Petiole and stipules may be lacking, but the blade, in the case of foliage leaves, is nearly always present. Besides being flat, green, and thin, the blade is *dorsiventral*, i. e., the under surface differs from the upper. It is usually situated in a more or less horizontal position—perpendicular to the rays of light.

As to *venation*, i. e., the course taken by the veins in the blade, there are two principal kinds of arrangement; *parallel-veined* and *netted-veined*. In the former condition, the larger veins, all of about equal size, run more or less parallel to each other, lengthwise of the blade, as in Orchids (Brooklyn Botanic Garden Conservatories, House 2), or branch from a central large vein (midrib) and then run parallel to each other, as in the Banana (center of House 5).

The leaves of most monocotyledons (grass, sedge, lily, orchid families, etc., whose seeds have an embryo with only one seed leaf or cotyledon) are parallel-veined, with, however, some exceptions. House 8 in the Conservatories is devoted to tropical monocotyledons. In the outdoor plantations the monocotyledons will be found west of the brook and north of the Ecological garden. The other principal kind of venation, the *netted-veined*, has veins of unequal size forming a network, the smaller veins or veinlets, especially, intersecting. The foliage leaves of the dicotyledons (plants with two seed leaves in the embryo, as in the bean, maple, etc.,) have netted-veined leaves. Good examples may be seen in Houses 3 and 4 as well as in the outdoor plantations. In addition to these two types of venation, another condition (called *uni-nerved*) is usual in needle-like leaves of the gymnosperms. Here only a single vein occurs, running lengthwise. (Pines, Spruces, etc., near the Lake).

With regard to the *shape of the blade* there are four main classes of foliage leaves; *orbicular* or approximately circular in outline, (East Indian Lotus, *Nelumbo nucifera*, in Lake; Nasturtium, Ecological garden); *ovate*, (Beech and Lilac in northwest part of Garden, Magnolia in triangular plot just west of Laboratory Building, and many others); *linear*, as in leaves of most grasses; and *needle-like* or *acicular* as in leaves of Heath, Pines, Spruces, etc. Between these principal forms there are many gradations; e. g. *obovate*, *cuneate* or wedge-shaped, *spatulate*, *lanceolate*, *oblanceolate*, *oblong*, *elliptical*, *oval*, etc.

As to the *outline* of the leaf margin, a great variety of forms exists, such as *entire*, where the margin is unbroken; *serrate*, with sharp teeth like a saw; *dentate*, or toothed; *undulate*, with a wavy margin; *sinnate*, with the undulations deeper (from *sinus*, a bay or gulf); *incised*; *lobed*; *cleft*; etc. These seem to have nothing to do with the leaf function, but are of great value in the description, and hence classification, of the various species of which they are characteristic. The base of the blade may be *cordate* or heart-shaped, *auriculate* or eared, *halberd-shaped*, etc. The apex, also, may be *acute*, *acuminate* or long-pointed, *obtuse*, *truncate*, *emarginate* or notched, *mucronate*, etc. These characters, too, are of great value in classification.

Finally, the blade may be undivided, in which case it is called *simple*; if divided into separate parts, called *leaflets*, it is said to be *compound*. In case the leaflets are attached along the sides of a central axis (*rhachis*), the leaves are called *pinnate*, (from Latin *pinna*, feather), or *pinnately compound*, as in the common locust, just west of the Lily Pools. Where the leaflets are attached at a single point, the leaves are called *palmate*, (from Latin *palma*, palm of the hand) or *palmately compound*, as in the horsechestnut, which may be seen in the outdoor plantations, with the Horsechestnut Family, near the walk and southwest of the locusts.

2. *Functions*. When one considers the great variety of foliage leaves and their almost universal occurrence—that the greenness of

vegetation is due to them and that they are one of the commonest sights of our everyday lives, it is one of the strangest facts of human existence that *comparatively few people know what a leaf is for*. This is the more remarkable when we couple with it the fact that our supply of food depends on the work of green leaves, so that without them, as things are at present constituted, the human race could not exist. For foliage leaves have the power of absorbing the very small amount of carbon dioxide (CO_2) that exists in ordinary air, and uniting it chemically with water (H_2O), brought up to them through the veins from the roots, to form sugar, which may be later changed by the plant to starch. The foliage leaves, then, are primarily *sugar-making* organs.

The energy derived from light is used by the leaf to bring about the chemical combination of these two substances— CO_2 and H_2O —and the tiny green bodies (*chloroplasts*) in leaves have the power of using this energy, deriving it mainly from the red waves of light, although the blue-violet waves help a little. The other light waves—mainly green and yellow—are not needed, and hence are reflected. This, then is the reason for the universal green color of vegetation, and this principal function of foliage leaves, i. e., sugar-making with the aid of light, is called *photosynthesis* (*photo*—light—*synthesis*—a putting together).

When we see a tree with perhaps thousands, or even hundreds of thousands of green leaves, we should think of it as it is—a living being, putting out this host of small organs, the leaves, somewhat as an octopus would put forth its tentacles—to get a supply of food. This is why the leaves are flat, so that they may be easily oriented in a plane suitable for receiving the rays of light to best advantage. They are thin, because, if thicker, the light would not penetrate beyond a certain point; they are green because this color represents the mixture of light waves not used in their chemical laboratories, and hence screened out or reflected.

Besides performing the function of photosynthesis, foliage leaves are important as organs of *transpiration*, i. e. in the giving off of water in the form of vapor; and in common with other parts of the plant they carry on *respiration*. Their ability to absorb CO_2 may also be classed as a special function.

II. FOLIAGE LEAVES WHICH HAVE ADDITIONAL FUNCTIONS

Here are classed those foliage leaves which, besides their regular work, have one or more additional functions.

a. Storage of Water. The leaves of many plants which live in dry regions (*xerophytes*), besides performing the function of food-making and the other functions named above, have taken on the added function of storage of water. In addition, many plants of the seashore and salt marshes (*halophytes*) have a similar leaf form—merely because in these regions fresh water is difficult to obtain.

A comprehensive collection of plants from desert regions of all quarters of the globe will be found in House 6 of the Conservatories. Conspicuous here are the Agaves or Century Plants on the further central bench. These are all natives of the dry table-lands of Mexico, over 300 species being known. The Mesembryanthemums, known commonly as Fig Marigolds, in the southwest corner of the house, also illustrate water-storing leaves, which are here not so firm as in the Agaves and so are called "succulent." Over 300 kinds of these plants grow in the arid plains in South Africa.

b. Catching and Holding Water. The leaf bases of many species of the Pineapple Family (Bromeliaceae, east bench of House 8) clasp the stem so tightly that water is retained in the cavity thus formed. In others (*Billbergia*) the leaves are arranged to form cylindrical tubes which serve this purpose. Since the great majority of these plants are "air plants," i. e., growing on rocks and boulders, trunks of trees, or even telephone and telegraph wires, without this provision for catching and keeping a supply of rain water they would soon dry out. These plants have been called "*cistern epiphytes*."

c. Storage of Food. The bulb scales of the hyacinth, filled with food to start the next year's hyacinth plant on its way in life, are the bases of foliage leaves, the upper parts of which wither away after having performed the function of photosynthesis.

d. Insectivorous Leaves. Here the leaves are formed in such a manner that insects are entrapped, their bodies being subsequently digested and absorbed by the plant as part of its food. The following may be seen at the Garden:

1. Pitcher Plant (*Sarracenia purpurea*), in which the blade is transformed into a pitcher holding water. Here insects are caught, drowned, and digested, and at the same time the green tissue performs photosynthesis. (House 4, west bench.)
2. The leaf of the Venus Fly Trap (*Dionaea muscipula*), a most interesting plant, native of South Carolina swamps, imprisons insects by suddenly folding together along the line of its midrib, as soon as they touch sensitive hairs on the leaf surface. In this plant the petiole is enlarged to help in the work of photosynthesis.
3. The tiny bladders which occur in abundance on the plants of the Bladderwort (*Utricularia*) serve as traps to catch water insects and animals. Once inside, the organisms are imprisoned, since the valve-like door shuts tight. Apparently their bodies are digested and used as food, since it appears from experiment that "plants deprived of animal food showed about one-half of the growth of those that were allowed to catch their prey in the usual way."¹ As to the morphology of the bladders, the most expert opinion seems to be that they are modifications of a part of a leaf—if indeed it is a leaf—for these leaf forms of Bladderworts have

¹Arber, Agnes. Water Plants, p. 95. 1920.

such remarkable qualities, namely, long continued apical growth, and the power of bearing leaves and axillary branches, etc., that they do not seem to fit at all into the morphological scheme of any plant organ. (House 4, west bench, and in the aquaria on the east bench.)

4. The leaves of the Sundew (*Drosera*), spread out flat in rosettes on the surface of bogs, are provided on their upper surfaces with numerous gland-tipped hairs, which secrete a sticky substance. These hairs are irritable, the longest, on the edges of the leaves, the most so, and when stimulated by contact with an insect, curve over the victim, enclosing it in their sticky secretion ("sundew") which contains digestive ferments. The nitrogenous substances obtained through this digestion are absorbed and used as food by the plants. It has been shown by experiment that individual plants deprived of such carnal fare do not develop as vigorously, although they do grow to maturity.² (House 4, west bench.)

e. With Tendrils or Twisting Petioles for Climbing.

Tendrils are slender, almost threadlike structures, which serve to attach the plant or part of it to a support. In members of the Pea Family (central part of outdoor plantations) one or more of the leaflets of each leaf may be transformed into tendrils. In many cases in this family the stipules are enlarged, and now do the chief part of the work of photosynthesis. Sometimes, as in Clematis (northern part of Crowfoot Family in outdoor plantations), the petiole, or leaf-stalk, is the part that twists around the support, thus enabling the plant to "hold on." Other examples of this last may be seen in House 3, where the twisting petioles assist the twining stems of various species of *Aristolochia*, namely, *A. elegans*, *galeata*, *brasiliensis*, etc. In the common Smilax or Greenbrier of our woods and fields (*Smilax rotundifolia*) and the less common species, *S. glauca*, the tendrils have been thought to be transformed stipules.

f. Developing Thorn-like Petioles for Clinging. An interesting case of a petiole which becomes, in part, a spine-like structure of advantage in helping the plant to climb, or rather to secure a firm hold on some support, is seen in the Rangoon Creeper (*Quisqualis indica*), a native of Malaya (House 5, near door of House 6). Here the petioles, after performing their normal function of holding the leaves outward, develop a joint about midway of their length, at which the outer portion, plus the leaf, falls off, leaving a short projection which becomes thornlike. Since the leaves are borne opposite each other, the result resembles a firemen's scaling ladder, where the steps are fastened to a single pole.

g. With Enlarged Petioles Serving as Floats. The petioles of the leaves of the Water Hyacinth (*Eichhornia crassipes*) are much enlarged, and contain air in their tissues. By means of these the

²Büsgen, M. Botanische Zeitung 41: 569. 1883.

plants float easily on the surface of the water. This species is a native of tropical and subtropical America, and it multiplies vegetatively often with such rapidity as to impede the passage of large river boats. (House 2, north end, also large pool in House 5, the large central conservatory.)

III. OTHER FORMS OF LEAF-LIKE NATURE OR ORIGIN

Here are classed all leaf forms which are not foliage leaves. In many cases, they, too, may perform photosynthesis during a part or all of their existence.

a. Cotyledons. Also known as the "seed leaves," these are the first leaves of the embryo, and are generally much simpler in form than the later foliage leaves. They may be much thickened, serving as reservoirs of food for the young plant, which, without such assistance, would be helpless. They may remain below the ground during germination, as in the pea, horsechestnut, oak, etc., and are then called *hypogeal*, from *hypo*—under, and *ge*—earth; or they may be lifted up into the air, become green and help in the work of photosynthesis, and are then known as *epigeal*, from *epi*—upon, and *ge*—earth. Examples of this latter class are the common bean, castor bean, apple, etc.

b. Scale Leaves.

1. *Ordinary Scale Leaves.* On erect shoots, scale leaves often appear as precursors of foliage leaves, and hence may become green, as in the Lily-of-the-Valley (*Convallaria majalis*) (west central part of Garden, near the Rose Garden). Scale leaves also occur regularly below the "eyes" or buds of potato tubers, although here they may be so much reduced as to be scarcely visible. They may be found on the rhizomes or underground stems of perennial grasses and other herbs, at the nodes; and in these instances, being pale, or without green color, are no longer functional. They may be seen at the bases of the green branches of Asparagus, the branches having taken over the function of food making, e. g. in *Asparagus plumosus*, south end of House 8, also on central bench, House 4. *Asparagus asparagoides*, also known as *Myrsiphyllum asparagoides*, from South Africa, and popularly called Smilax, but not really a true Smilax, has similar scale leaves, the morphological representatives of the foliage leaves, at the bases of the leaf-like branches or cladophylls. The Butcher's Broom (*Ruscus aculeatus*), from Europe (west bench in House 11) shows a similar condition. All scale leaves, including also most bud scales, are to be regarded as foliage leaves in an arrested state of development.

2. *Scale Leaves for Storage of Food.* The thick bulb scales of the lily are specialized, having taken on the function of storage of food.

3. *Bud Scales.* The winter buds of most of our woody plants are wrapped in protective scales, called bud scales, which are usually without green coloring and which in most cases represent the base of a foliage leaf, the blade remaining undeveloped; e. g. lilac, elm, horsechestnut, etc. All these bud scales belong in the category of scale leaves. Sometimes, however, as in the tulip tree and magnolia, the bud scales represent transformed stipules.

c. Bracts. These are small, leaf-like structures ordinarily appearing in the region of the flower. The "heads" of the dandelion and daisy flowers, for example, are subtended at the base by a large number of bracts (in this case green) called collectively the "involucre." Often, in flower clusters, one of these small leaves subtends each flower. In the latter case they have apparently no special function, but represent foliage leaves in an arrested state of development. But in the Linden the bract attached to the flower cluster serves as a sail so that the fruit may be carried by the wind some distance from the parent tree. Often bracts in the region of the flower are highly colored, thus taking on the function of attracting insects for cross pollination, the true flowers in these cases being usually inconspicuous. Examples are *Poinsettia* (Central or Economic House) and *Buginvillaea*, (House 3, east bench, and House 12, east bench). The four large, white bracts surrounding the central cluster of small flowers in the Flowering Dogwood (*Cornus florida*), are bud scales which develop into this showy form just before the flowers open.

d. Floral Leaves. The sepals, the outer green envelope of the typical flower, as well as the petals, the variously colored inner envelope, are morphologically leaves. The sepals, being green, assist in the work of photosynthesis as well as protecting the inner parts of the flower in the bud. The bright color of petals attracts insects for cross pollination. Furthermore, stamens and carpels are also of leaf-like nature, being sporophylls, or spore-bearing leaves. Common flowers which show all these parts well are the buttercup and the wild rose. The evolution of the parts of the flower is discussed in a former LEAFLET (Series XI, No. 9. 1923).

The "green rose", *Rosa chinensis viridiflora*, which may be seen in the northeastern corner of the Rose Garden, seems to be a clear case of reversion of the floral parts to their former leaf-like condition. The flowers are small—from an inch to an inch and one-half in diameter. The five-parted calyx beneath is perfectly normal, but petals, stamens, and pistils are replaced by narrow, green, leaf-like structures, veined and even serrated like the foliage leaves themselves.

e. Phyllodes. These forms are also cases where, as in most bud scales, the leaf blade has been suppressed in its development, but here the petiole has expanded and now takes on the function of photosynthesis. Good examples are seen in several species of Acacia, e. g. *Acacia melanoxylon*, in House 11 near the north end of the central plot. Most interesting gradations may be seen here on the same plant,

from compound leaves to phyllodes. Forms may be seen with tiny leaflets still persisting at the tip of the phyllode. In a case like that of the Acacias, whose hereditary leaf form is much divided, these plants are obviously much better adapted to a life in dry regions by forming this leaf-like, flattened petiole—usually extending in a more or less vertical plane with respect to the ground—than by exposing numerous small leaflets to the intense sunlight.

f. Spines. Cases of the transformation of the leaf blade into a spine or spines are seen in the Barberries, where the 3-pronged spine (*Berberis vulgaris*, outdoor plantations) may be regarded as evidence that the leaf of the ancient barberries was compound. In the Japanese Barberry, (*B. Thunbergii*) the evolution has gone further, for here the spines are simple. The fact that buds and branches arise in the axils of these spines proves their leaf-like nature. The huge, twin thorns of the Bull's Horn Thorn (*Acacia sphaerocephala*), from Mexico (House 4, west bench) are obviously of stipular origin. The same is true of the paired spines in the Common Locust (*Robinia Pseudoacacia*) west of the lily pools. The thorns of the cacti, e. g., species of *Opuntia*, are, in many cases at least, the morphological equivalents of leaves. Here the flattened, leaf-like stem carries on the work of photosynthesis.

SUMMARY

I. TYPICAL FOLIAGE LEAVES

1. *Form.* Various, but typically thin and dorsiventral.
2. *Functions.* Mainly for photosynthesis, but also perform transpiration, respiration, and absorb CO₂ from air.

II. FOLIAGE LEAVES WHICH HAVE ADDITIONAL FUNCTIONS

a. Storage of Water

Agaves, Mesembryanthemums, etc., House 6.

b. Catching and Holding Water.

Lvs. with clasping bases or otherwise arranged to hold water.
Members of Pineapple Family. House 8.

c. Storage of Food.

Fleshy bases of hyacinth lvs.

d. Insectivorous Leaves.

Pitcher Plant, *Sarracenia purpurea*, Venus Flytrap, *Dionaea muscipula*, Bladderwort, *Utricularia*, and Sundew, *Drosera*, all in House 4.

e. With Tendrils or Twisting Petioles for Climbing.

Leaflets transformed into tendrils.

Members of Pea Family, outdoor plantations.

Petiole twines about support.

Clematis, outdoor plantations, Aristolochias, House 3.

Stipules transformed into tendrils.

Greenbrier, *Smilax rotundifolia*, and *S. glauca* of our woods and fields.

f. Developing Thorn-like Petioles for Clinging.

Rangoon Creeper, *Quisqualis indica*. House 5.

g. With Enlarged Petioles Serving as Floats.

Water Hyacinth, *Eichhornia crassipes*, Houses 2 and 5.

III. OTHER FORMS OF LEAF-LIKE NATURE OR ORIGIN

a. Cotyledons.

b. Scale Leaves.

1. Ordinary Scale Leaves.

Precursors of foliage lvs., as in Lily-of-the-Valley, west central part of outdoor plantations. Also on potato tubers, and underground stems of perennials. At bases of green branches of Asparagus, House 8, and also in same position in florist's "Smilax," *Asparagus asparagoides*. Likewise in Butcher's Broom, *Ruscus aculeatus*, House 11.

2. Scale Leaves for Storage of Food.

Bulb scales of lily.

3. Bud Scales.

Winter buds of most woody plants, as lilac, elm, horsechestnut, etc. (outdoor plantations).

c. Bracts.

Flower heads of dandelion, daisy, etc.

Flower heads of flowering dogwood. Outdoor plantations.

Flowers of Poinsettia, House 5, and of Buginvillea, Houses 3 and 12.

Sail-like bracts of linden, (*Tilia*). Outdoor plantations.

d. Floral Leaves.

Sepals, petals, and sporophylls (stamens and carpels) of flowers. The "green rose" *Rosa chinensis viridiflora* in the Rose Garden.

e. Phyllodes.

Acacia melanoxylon and other species. House 11.

f. Spines.

Leaf blade transformed to simple or branched spine. Barberies in outdoor plantations: Opuntia, etc., House 6.

Stipules transformed to thorns.

Bull's Horn Thorn, *Acacia sphaerocephala*, House 4.

Black Locust, *Robinia Pseudoacacia*. Outdoor plantations, west of the perennial lily pool.

ARTHUR HARMOUNT GRAVES.



FIGURE 1.—Riker mount showing various forms of leaves. Prepared by the Brooklyn Botanic Garden for loan to the schools.

NOTICES

The Garden is open free to the public daily, from 8 a. m. until dark; on Sundays and holidays from 10 a. m. until dark. The Laboratory Building, containing the Library, Herbarium, and offices, is open daily (except Sundays), from 9 a. m. until 5 p. m. (Saturdays, 9-12). The Conservatories are open April 1-September 30, 10 a. m.-4:30 p. m. (Sundays, 2-4:30); October 1-March 31, 10 a. m.-4 p. m. (Sundays, 2-4). **The Japanese Garden** is open every day from 11 a. m. until dusk; on Sundays and holidays from 1 p. m. until dusk. **The Rose Garden** is open from 9 a. m. to 5 p. m. on weekdays. It is closed on Sundays and holidays.

The Garden may be reached in the following ways: Flatbush Avenue trolley to Empire Boulevard; Franklin Avenue or Lorimer Street trolleys to Flatbush Avenue; St. John's Place trolley to Sterling Place and Washington Avenue; Ninth Avenue, Union Street, Vanderbilt Avenue, or Smith Street trolleys to Grand Army Plaza and Union Street; Brighton Beach Express, Broadway (B.M.T.) Subway to Prospect Park (north exit). From Pennsylvania Station, Manhattan, take Broadway-Seventh Avenue Subway to Eastern Parkway-Brooklyn Museum Station. From Grand Central Station, Manhattan, take Lexington Avenue Subway, changing at Nevins Street, Brooklyn, to Broadway-Seventh Avenue Subway, getting off at Eastern Parkway-Brooklyn Museum Station. **By Automobile** from points on Long Island, take Eastern Parkway and turn left at Washington Avenue; from Manhattan, take Manhattan Bridge, follow Flatbush Avenue Extension and Flatbush Avenue to Eastern Parkway, turn left following Parkway to Washington Avenue; then turn right.

Entrances—On Flatbush Avenue (1) near Empire Boulevard, and (2) near Mt. Prospect Reservoir; on Washington Avenue, (3) south of Eastern Parkway, and (4) near Empire Boulevard; on Eastern Parkway, (5) west of the Museum building.

The Street entrance to the Laboratory Building is at 1000 Washington Avenue, between Eastern Parkway and Empire Boulevard and opposite Crown Street.

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SERIES XIX

BROOKLYN, N. Y., DECEMBER 2, 1931

No. 10

DECEMBER IN YOUR GARDEN

One of the things that we are most concerned about in the garden during this month is the provision of protection to those plants out of doors that might fail to survive the winter without it.

Evergreens. Evergreens of the coniferous type are benefited by having a mulch of strawy manure, partly decayed leaves, or peat moss placed on the soil over their roots. This prevents the soil from freezing too deeply, so that the roots are able to draw on the water supply in the soil when transpiration of moisture from the leaves makes this necessary. Much of the damage to evergreens is brought about by strong winds and sunshine which remove the moisture from the green parts of the plants. In the case of the varieties that are very susceptible to winter injury, it is often desirable to protect the tops of the plants from strong winds and sun by means of lath screens or burlap.

Of the broad-leaved evergreens, the rhododendron is perhaps the most important. This should have a layer of leaves, 6 in. to 1 ft. thick, preferably of oak or beech, placed over the roots. Newly planted stock may receive the additional protection of something that will screen the foliage from sun and wind.

Valuable boxwoods may be protected by building a light wooden framework over them and covering this with burlap.

Deciduous Shrubs. Of the deciduous shrubs commonly grown that require winter protection, the most important are the hydrangeas belonging in the Hortensia group, sometimes called French hydrangeas. Some of these varieties produce their flowers only from terminal buds or from buds near the tip of the shoot. As these varieties are liable to be killed back in a severe winter, it is worth while to protect them in order to insure a crop of blossoms the following year. There are various methods of doing this. A very desirable one, which, however, entails a good deal of work, is to place a box without top or bottom over the plants, and fill it with earth. Another method of caring for them is to tie the canes together and cover them with burlap, straw, salt hay, or cornstalks—anything that will keep off sun and wind and bring about a more equable temperature in the vicinity of the shoots.

Roses. Many of the garden roses, of course, will come through the winter without any protection whatever. The hybrid perpetuals belong in this class. However, even with these, it is often desirable to perform a few kindly offices that will help them come through the winter uninjured. Roses in this group often make very strong canes, offering a good deal of wind resistance. These canes may be whipped about by the wind to such an extent that the plant is screwed off, as it were, from its roots at or near the surface of the ground. These excessively long canes should be shortened back and the soil made firm around the collar of the plant by stamping on it with the feet. If these measures do not result in anchoring the plant firmly in the ground, a stake should be driven in and the canes tied to it. Some of our most delightful climbing roses, such as "Emily Gray," "Jacotte," and "Gloire de Dijon," may have their canes killed to the ground in a severe winter, unless measures are taken to protect them. In severe climates, the best way to do this is to take the canes from the trellis on which they are growing, bend them to the ground, and then cover them with earth. In Brooklyn and vicinity, the canes may be taken from their support, tied in bundles, and wrapped with cornstalks.

Many of the hybrid teas are capable of surviving the winter without protection, but on general principles it is well to hill them up with earth and mulch them with manure, but do not let the manure come into contact with the rose stems. The tops that are still protruding may be protected by covering them with evergreen branches, or by scattering salt hay amongst them. Another method of protecting these roses, that is very effective and workable when the roses are planted in compact beds, is to build a board fence about 2½ feet high around the bed and cover the top with lath screens.

Perennials. The perennial garden should have a mulch of 2" or 3" of partly decayed manure. Do not make the mistake of putting the manure over perennials that have evergreen foliage, like Foxglove, Pinks, Perennial Candytuft, etc. Red Hot Pokers (*Tritoma*) should have a pailful or two of leached coal ashes spread over their crowns.

Bulb Beds. When the ground has frozen an inch or so deep, the bulb beds should be mulched with about 2" of partly decayed manure. If manure is not obtainable, peat moss may be used as a substitute.

Rock Garden. Do not mulch your alpine plants with manure. A light top dressing of about ½" of an equal mixture of ¼" crushed stone, leaf mold, and garden soil is beneficial. Those plants that have evergreen foliage are best protected by means of evergreen branches lightly thrown over them. If evergreen branches are not available, salt hay or oak leaves may be substituted.

Lawns. It is not necessary to mulch lawns in this climate to protect them over winter. It is, however, desirable to put on a mulch that will provide plant food. This may consist of thoroughly decayed stable manure. Do not use fresh or partly decayed manure, as this may be the means of introducing weed seeds into the lawn. If there

are any objections to manure on the score of its appearance, one of the many proprietary brands of dehydrated and processed organic manures may be used.

Lily Pools. If your pool is small in size, it may be protected by covering with boards and then with a layer of straw or leaves. This will prevent the water from freezing deep enough to harm hardy lilies, gold fish, or the tank itself. Another method of taking care of the pool over winter is to drain off the water and cover the water lilies with leaves so as to prevent their crowns from freezing.

Soil Improvement. Heavy clay soil should be spaded up before winter sets in and left rough, so that the soil may experience the beneficial effects of freezing. If it is necessary to wheel manure over lawns, wait until the ground has been frozen so that the wheels do not make ruts in the turf.

Planting. Planting of hardy deciduous trees and shrubs, with the exception of oak, birch, magnolia and those that are doubtfully hardy, which are best planted in the spring, may be continued during this month so long as the weather remains open.

MONTAGUE FREE.

BANANAS AT THE BROOKLYN BOTANIC GARDEN

The large banana plant in the Central or Economic House of the Conservatories now bears at its tip a good-sized bunch of green bananas which has been gradually developing all summer and fall. That their harvest time is near is evidenced by the faint yellowish tinge stealing over the fruit and by the paler green of the upper leaves and leaf stalks.

According to the Garden records, this is the eleventh crop of bananas borne by this particular plant, which was obtained from the United States Department of Agriculture in 1914 and planted where it now stands in the Economic House in April of that year. After about eighteen months, namely in October, 1915, it produced its first crop of fruit borne on Brooklyn soil, and the rich buttery flavor of the product proclaimed it to be a particularly excellent variety. The next bunch ripened about November 1, 1916, or thirteen months after the first. During 1917 no crop was produced, probably because of the lower temperature in the Conservatories, due to the coal shortage. In August, 1918, the third crop matured, and since that time up to the present there have been eight more banana harvests at the Garden, the average lapse of time from one crop to the next being about nineteen months.

As everyone knows, the seeds of commercial bananas are mere apologies for seeds—dark specks in rows running lengthwise along the center of the fruit. These seeds contain no embryos and hence will not grow into new plants—in technical language, they are not *viable*. The domestic species of banana, *Musa sapientum*, has always had these tiny, abortive seeds, and so, for all practical purposes, is seedless.

How, then, are new plants produced? New plants, or rather new shoots, arise from buds which develop on the thickened underground stem or *rhizome*. Each new shoot, or "banana plant," attains a height of about eighteen feet, blossoms, bears fruit, and dies, the next crop being produced by another shoot from the same rhizome. In the plant at the Garden the next shoot on which the task of fruit bearing will devolve is patiently waiting its time. It stands in front of the old one, a little nearer the path, and is already about nine feet high. One can even discern a third shoot, about two feet high, on the further side of the old plant ready to "carry on" whenever its time shall come. As soon as any shoot matures its fruit, it is cut off down to the ground, for otherwise it would wither and decay. Stumps of former "generations" may be seen near the base of the present plant.

Perhaps the most interesting thing about the banana plant at the Garden, and about all other banana plants of this species, for that matter, is the fact that they are really parts or pieces of the same plant, for since the species is seedless the only means of reproduction is by the growth of its underground stem, which may be cut in sections and thus furnish new plants, after the fashion of the tubers of the potato or the runners of the strawberry.¹

As to the origin of the seedless form no records exist. The banana is probably older than the human race, and several species of *Musa* exist to-day in which the fruit has no pulp but consists merely of the outer rind and large seeds filling up the cavity, like peas in a pod; other varieties have a small amount of pulp. Primitive man, whose food was precarious, must have always been on the lookout for valuable food plants and therefore eagerly appropriated this seedless variety with pulpy fruit. Any valuable variations which appeared in nature from time to time must have been carefully preserved. Such selection has been going on from time immemorial. About 100 years ago an improvement on the ordinary fruit was discovered on the island of Martinique. This was introduced into cultivation in Jamaica and came to be known as the Jamaican or Gros Michel banana and is today the only one that is cultivated in Jamaica, Costa Rica, and elsewhere for export.

Two other species of *Musa* may be seen at the Economic House: both are a little to the northward of *Musa sapientum*, and not far from the entrance to House 4. These are the Chinese banana, *M. Cavendishii*, and the Manila hemp, *M. textilis*. The former is a dwarf species which grows from a height of from four to six feet, with smaller fruit than that of the Jamaican banana, but also seedless and edible—a native of Southern China. The other, the Manila hemp, is a native of the Philippines and much cultivated there for its valuable fiber, which is extensively used in the manufacture of rope. Its fruit is inedible.

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¹ Such a group of individuals, propagated vegetatively, and all derived from a single plant, is known technically as a *clone*.

